Center Independent Research & Development: GSFC IRAD

Using Heliospheric Imager Data to Improve Space Weather Forecasting

Completed Technology Project (2012 - 2013)

Project Introduction

The NASA/GSFC's Space Weather Center (SWC) uses the WSA-ENLIL-Cone numerical modeling system to predict key transient solar wind features in the inner heliosphere, and thus provides near real time support to NASA mission operations. This project propose to implement and test modifications to the way in which this model executes, which will allow it to make use of STEREO A and B Heliospheric Imager (HI) data, thus promising to significantly reduce errors in forecasts made using the model. If successful, the approach would provide key support for the future development of flight missions carrying Heliographic Imagers to L4 and L5.

The objective of this project is to test a new approach for selecting the optimal solar wind model from an ensemble of model runs. Because of the paucity of real time solar wind measurements, numerical heliospheric models are an essential element in space weather forecasting. At any given time coupled corona/inner heliosphere models can be generated from a number of available solar photospheric synoptic magnetograms. Validation studies have shown that the average error of the ensemble of models when forecasting the arrival time of geo-effective fast wind streams is typically 1 to 2 days. Usually one or more of the models at a given time gives a significantly better forecast than the average, but over a solar cycle, no synoptic magnetogram source clearly outperforms any other. There has been no way, in near real time, to identify which magnetogram source leads to the best forecast. This project propose to test a new approach, which uses observations of structure in the solar wind close to the Sun obtained from the STEREO A and B Heliospheric imagers. By identifying which of the possible forecast models best fits the Heliospheric Imager data, the expectation is to be able to significantly improve the forecasts of the arrival times of fast solar wind streams at Earth. The WSA-ENLIL model is acknowledged to be the most physically complete model of the inner heliosphere currently in active use for solar wind forecasting. Therefore the WSA-ENLIL model was chosen to use it to demonstrate the effectiveness of this new approach. The first deliverable at the end of this project will be an updated version of the WSA-ENLIL model, configured to run in ensemble mode using a different synoptic magnetogram source for each run of the model, and with newly developed routines supporting acquisition and use of the Heliospheric Imager data, and automatic identification of the optimal forecast run. The second deliverable will be a validation study of the new approach reporting the improvements achieved in forecasting fast stream arrival times. The initial goal is not to deliver an operational forecasting tool, but to demonstrate that this approach has the capability to dramatically improve forecast quality. The aim of follow on efforts would be to refine and optimize the procedure, and to modularize components so they can be used with alternative coupled corona/inner heliosphere models in use in both the operational forecasting community and the scientific research community. In addition by demonstrating that the new procedure will significantly improve forecast quality, we would support advocacy of any flight missions which

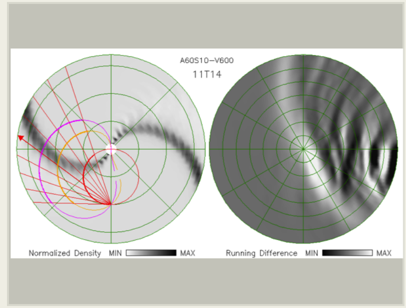

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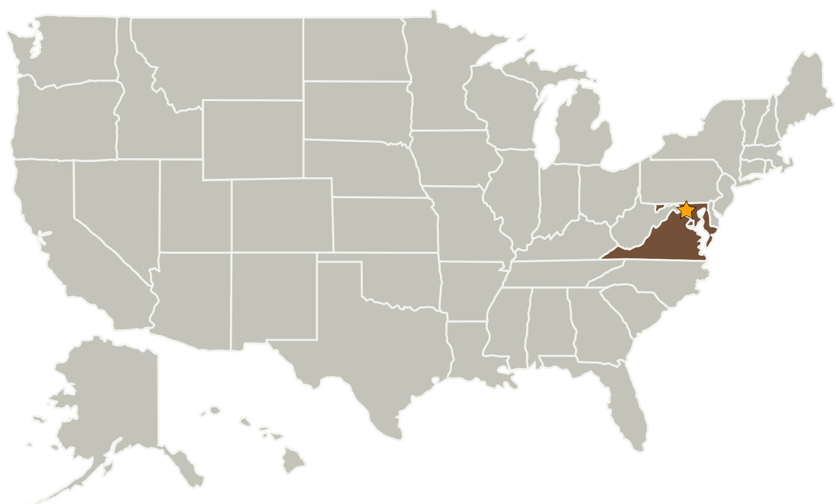
Table of Contents

would provide a Heliospheric Imaging capability comparable to that which is currently available from STEREO A and B.

Anticipated Benefits

Improved forecasting of the arrival times of fast solar wind streams will enable mission operations to take any required protective actions to safeguard NASA assets.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
District of Columbia	Maryland
Virginia	

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Manager:

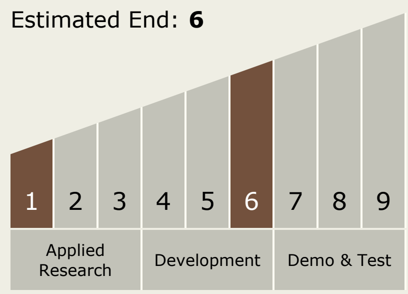
Nikolaos Paschalidis

Principal Investigator:

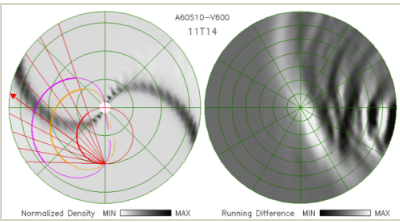
Peter J Macneice

Technology Maturity (TRL)

Start: **1**
Estimated End: **6**



Images



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Using Heliospheric Imager Data to Improve Space Weather Forecasting
(https://techport.nasa.gov/image/1855)

Project Website:

http://sciences.gsfc.nasa.gov/sed/

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - └─ TX06.5 Radiation
    - └─ TX06.5.4 Space Weather Prediction